9.7.21

Home Assignment

1) The radius of the circular path by the proton in the magnetic field change can be describe as

$$r = \frac{1}{B}\sqrt{\frac{2m_1 V}{q}}$$

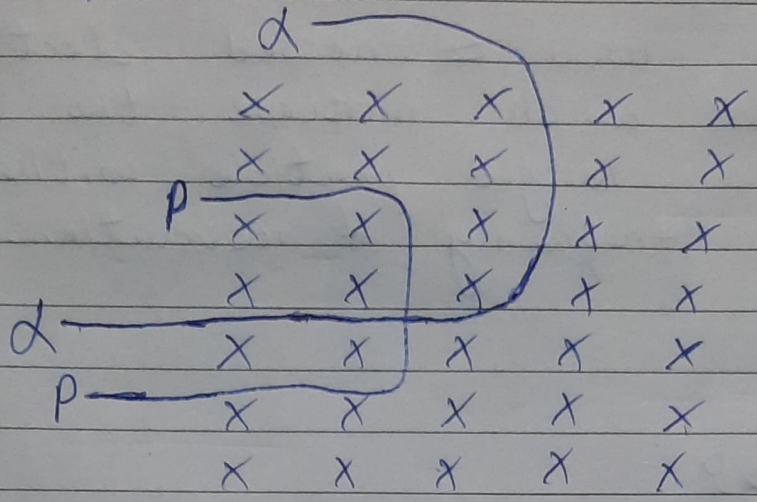
b is the magnetic field.
V is the potential.

$$r \propto \sqrt{V}$$

$$\frac{r'}{r} = \sqrt{\frac{2V}{V}} = \sqrt{2}$$

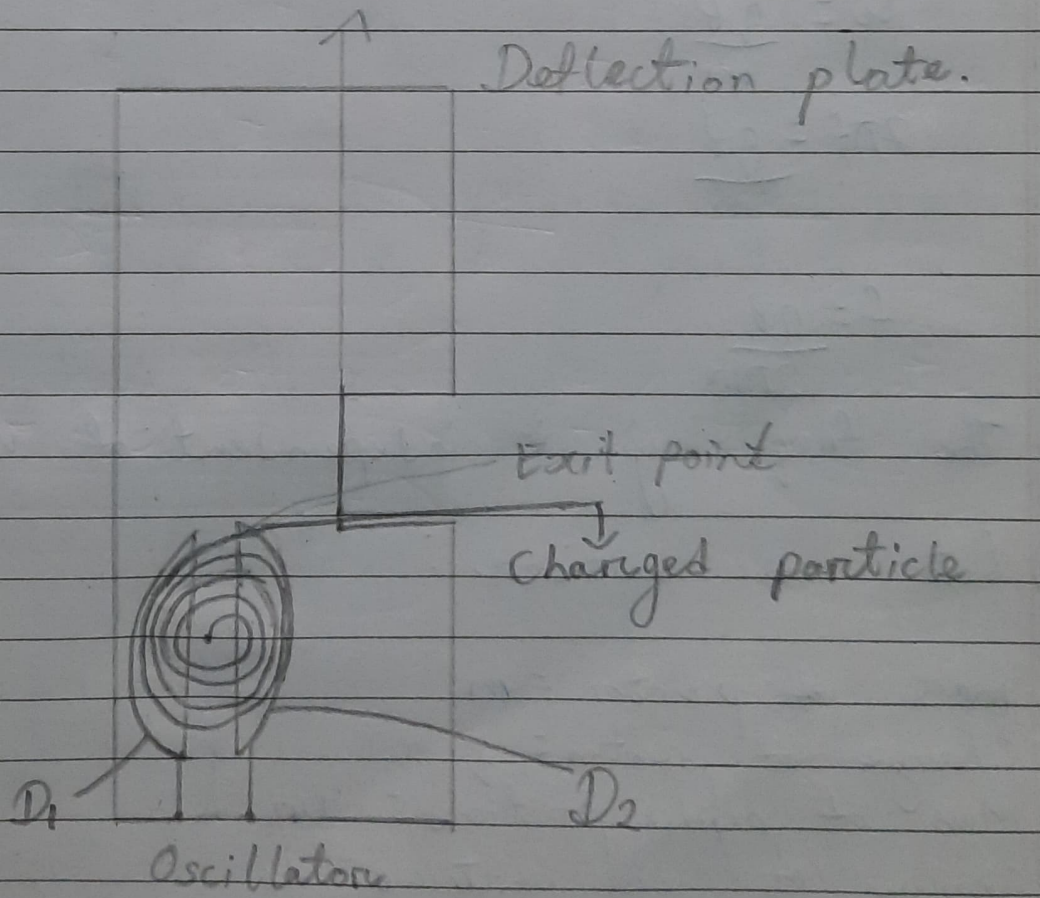
$$r' = \sqrt{2}r$$

2) $r = \frac{mv}{qB}$



$$\frac{r_p}{r_\alpha} = \frac{(m/q)p}{(m/q)\alpha} = \frac{(mp/e)}{(4mp/2e)} = \frac{1}{2} = 1:2$$

3)



Working principle of Cyclotron:

The cyclotron used crossed electric & magnetic field which increase the Kinetic energy of a charged particle without changing its frequency of revolution.

$$F_c = F_m$$

$$\frac{mv^2}{r} = qvB$$

$$\frac{v}{r} = \frac{qB}{m}$$

$$\omega = \frac{qB}{m}$$

$$2\pi f = \frac{qB}{m}$$

$$f = \frac{qB}{2\pi m}$$

The frequency is independent of velocity.

(a) Let us consider:

mass of proton = m
Charge of proton = q
Mass of alpha particle = 4m
Charge of alpha particle = 2q

Cyclotron frequency $\nu = \frac{Bq}{2\pi m}$ $\Rightarrow \nu \propto \frac{q}{m}$

For proton: frequency $\nu_p \propto \frac{q}{m}$

For α particle: frequency $\nu_q \propto \frac{2q}{4m} \Rightarrow \nu_q \propto \frac{q}{2m}$

Thus particle will not accelerate with same cyclotron frequency. The frequency of proton is twice than the frequency of α- particle.

b) Velocity $V = \frac{Bqr}{m}$ $\quad V \propto \frac{q}{m}$

For proton: velocity $V_p \propto \frac{q}{m}$

For α particle: velocity $V_q \propto \frac{2q}{4m} \Rightarrow V_q \propto \frac{q}{2m}$

Thus particle will not exit the dees with same velocity. The velocity of proton is twice than that of α particle.

5) α- particle will trace circular path in clockwise direc^n. Its deviation will be in the direction $(\vec{V} \times \vec{B})$.
i.e $\perp$ to velocity of particle.

Neutron will pass without any deviation as magnetic field does not exert neutral particle.

Electron will trace circular path in anticlockwise direc^n & deviation will be in direct^n opp to $(\vec{V} \times \vec{B})$ with smaller radius due to large charge/mass ratio as $r = \frac{mv}{qB}$.